

Pipe Standards

November 5, 2009

Agenda

- Purpose of revisions
 - 15 minutes
- Revisions overview
 - 20 minutes
- In depth explanation of Specifications and Standard Drawing revisions
 - 60 minutes
- Pay item examples
 - 20 minutes
- Critical inspection points
 - 5 minutes


PDH Credits

- PDH Credits: The Department does not report credits for classes that last less than ½ day. Professional Engineers and Land Surveyors can self report this Webinar. It will be 2 hours of structured time.
- All who signed in will receive a “Thank you for attending” email.

There was this



FRAGILE

handle with 

Then, there was this...



To drain the water, we needed
some pipes...



Why are we here today?

- To improve pipe installation through a thorough understanding of the revised standards
- To reduce bumps in the road
- Conducted pipe installation training two years ago and we are not focusing on that today
- New standards and specifications provide new materials and details to improve performance of each pipe system
- Expand the use and understanding of alternate pipe materials

FHWA Guidance concerning alternate pipe materials SAFETEA-LU

Section 5514 of the "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users," enacted August 10, 2005, requires the Secretary, within 180 days, to "... ensure that States provide for competition with respect to the specification of alternative types of culvert pipes through requirements that are commensurate with competition requirements for other construction materials, as determined by the Secretary."

...policies that consider all available pipe products judged to be of satisfactory quality and equally acceptable on the basis of engineering and economic analyses. Given the differences in climate, environment and topography, we anticipate that there will be differences in culvert selection policies between various states.

With the potential for significant savings, the implementation schedule should not be based on protracted evaluation periods for experimental or pilot project installations

As previously noted, State DOTs should develop culvert selection policies that consider all available pipe products judged to be of satisfactory quality and equally acceptable on the basis of engineering and economic analyses

Memorandum

U. S. Department of Transportation
Federal Highway Administration

Subject: Information: Culvert Selection Procedures

Date: July 9, 2007

From: /S/ Original signed by
Dwight Horne
Director Office of Program Administration

In Reply Attn. of: HIPA-30

To: Division Administrators
Resource Center Managers
Directors of Field Services

This memo supplements our [November 30, 2006 memorandum regarding implementation issues associated with the November 15, 2006 final rule for SAFETEA-LU Section 5514](#).

As previously noted, State DOTs should develop culvert selection policies that consider all available pipe products judged to be of satisfactory quality and equally acceptable on the basis of engineering and economic analyses. Given the differences in climate, environment and topography, we anticipate that there will be differences in culvert selection policies between various states.

Since the effective date of the regulation was December 15, 2006, Division Offices should now be working with their respective State DOTs to ensure that the State's culvert material selection procedures provide for competition with respect to the specification of alternative types of culvert pipes. Division Offices should ensure that the States' procedures are based on sound engineering and economic reasons and not based on arbitrary factors.

While a number of states have significant experience with the design and construction of flexible culvert installations, many states do not. It has always been FHWA's policy to encourage the use of proven materials in states that may not have experience with these products. Historically, we have encouraged systematic implementation plans and measured approaches in implementing materials in states that do not have experience with a given product even if the product has been successfully used in other States. We have promoted this approach to avoid failures resulting from inappropriate use, inexperience, and/or improper construction techniques.

Where the State and Division Office agree that material selection policy revisions are appropriate, a reasonable implementation schedule should be initiated. With the potential for significant savings, the implementation schedule should not be based on protracted evaluation periods for experimental or pilot project installations. Division Offices should be mindful of the States' need to gain the needed experience, but this need should not be used to delay the implementation for unreasonably prolonged periods of time.

Given the Congressional intent of Section 5514 of ensuring that the States provide for competition with respect to the specification of alternative types of culvert pipes, we have developed an informational web page titled, "[Construction Program Guide, Culvert Selection](#)," for states that are still considering revisions in their culvert selection policies to provide for a wider application of culvert materials. The web page provides links to the Section 5514 statutory and regulatory requirements, FHWA informational memoranda, and links to AASHTO documents related to the design, materials and construction criteria for various culvert installations. The site also provides links to State DOT culvert selection policies for a sample state in each of the four AASHTO regions.

If you have any questions on this matter, please contact Gerald Yakowenko in my office at 202-366-1562.

- Conferences
- Software
- Policy & Memos
- Research
- Publications
- Training & Workshops
- Staff
- Links



U.S. Department of Transportation
Federal Highway Administration

Memorandum

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Related Features

- [07/09/07 Memo: Culvert Selection Procedures](#)
- [Construction Program Guide](#)
- [FHWA Contract Administration](#)

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Subject: ACTION: Pipe Selection Final Rule

Date: November 30, 2006

From: /S/ Original signed by
Dwight Horne
Director Office of Program Administration

In Reply Attn. of: HIPA-30

To: Division Administrators
Resource Center Managers
Directors of Field Services

For your information, a final rule to implement Section 5514 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users was published in the Federal Register on November 15, 2006. The final rule amends our material selection policies to support the competitive bidding principles in Section 112 of Title 23 U.S. Code.

With the December 15, 2006 effective date of the final rule, the States should be considering all available pipe products that are judged to be of satisfactory quality and equally acceptable on the basis of engineering and economic analyses. Where such products appear to be equal, alternative bidding practices must be used as required by 23 CFR 635.411(b). Where alternative products are determined to have different engineering and economic properties, contracting agencies may select a specific material or product based on the required engineering properties and/or life cycle cost criteria. In such cases, the State DOT should document its material selection decision on a project or program basis as appropriate.

We encourage you to work with your respective State DOTs to develop pipe selection procedures to efficiently implement the revised policy. If you have any questions on this matter, please contact Gerald Yakowenko in my office at 202-366-1562.

This page last modified on 07/10/07

Culvert Selection - Construction Guide - Construction - FHWA - Windows Internet Explorer

http://www.fhwa.dot.gov/construction/cqit/culvert.cfm

U.S. Department of Transportation
Federal Highway Administration

Construction

Quality Management & Coordination Details Safety Materials Contract Administration

FHWA > Engineering > Construction > Construction Guide > Culvert Selection

<p>Construction Guide</p> <ul style="list-style-type: none"> Fact Sheets Links Memos Publications Research Reviews Technical Advisories Training & Workshops 	<p>Construction Program Guide</p> <p>Culvert Selection</p> <p>The FHWA's policy for culvert selection requires the State DOTs to consider all available pipe products that are judged to be of satisfactory quality and equally acceptable on the basis of engineering and economic analyses.</p> <p>Authority/Legal Basis</p> <p>1. Laws</p> <ul style="list-style-type: none"> Section 5514 of the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act, titled "Competition for Specification of Alternative Types of Culvert Pipes," requires the Secretary of Transportation to ensure that States provide for competition with respect to the specification of alternative types of culvert pipes. Section 5514 specifically states: <p><i>"Notwithstanding any contrary interpretation of appendix A of subpart D of section 635.411 of volume 23, Code of Federal Regulations (as in existence on the date of enactment of this Act), not later than 180 days after the date of enactment of this Act, the Secretary shall ensure that States provide for competition with respect to the specification of alternative types of culvert pipes through requirements that are commensurate with competition requirements for other construction materials, as determined by the Secretary."</i></p> <p>2. Regulations</p> <ul style="list-style-type: none"> The FHWA implemented Section 5514 by revising 23 CFR 635.411 through the rule making process. This included an April 17, 2006 Notice of Proposed Rule Making and a November 15, 2006 Final Rule. Docket comments for the rule may be viewed at 	<p>Events</p> <ul style="list-style-type: none"> View all Upcoming Construction Events <p>More Information</p> <ul style="list-style-type: none"> Contract Administration Hydraulics <p>Contact</p> <p>Jerry Yakowenko Office of Program Administration 202-366-1562 E-mail Jerry</p> <p>Construction Feedback E-mail Construction</p>
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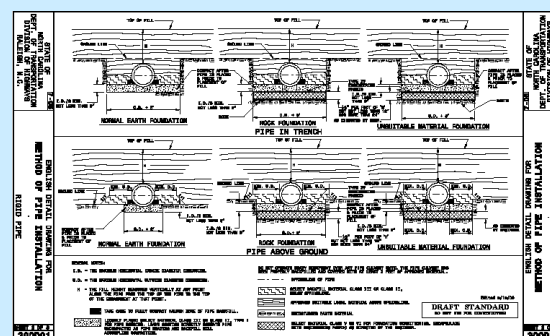
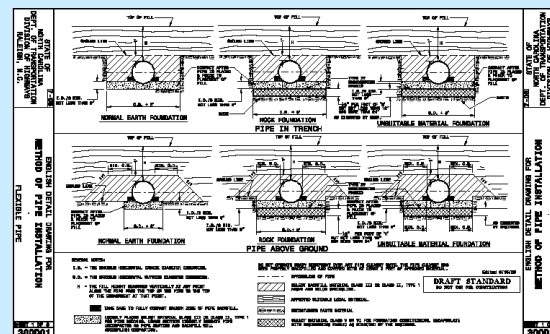
- The [FHWA's July 9, 2007 memo](#) supplements the November 2006 memorandum regarding implementation issues associated with the November 15, 2006 final rule for SAFETEA-LU Section 5514.
- The [FHWA's November 30, 2006 policy memo](#) notifies FHWA Division Offices of the effective date for the final rule and encourages them to work with their State DOTs to implement the revised policy.
- The [FHWA's October 6, 2005 policy memo: "SAFETEA-LU Section 5514"](#) provides a interpretation of Section 5514 shortly after the enactment of SAFETEA-LU.
- The [FHWA's May 11, 2005 policy memo: "Guidance on Pipe Selection"](#) provides a pre-SAFETEA-LU interpretation of FHWA's policy.

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What

- 3 pages instead of 4
- Revised provisions
- Flexible and rigid
- Select material
- Spring line
- Fill height tables
- Post inspection
- ~~Method B~~
- Arch pipe and structural plate pipe
- Numbering scheme
- Drainage Pipe special provision



FLEXIBLE PIPE

Single Occurrence Bore Pipe				Single Occurrence Aluminum Pipe				
Class	Minimum Diameter (mm)	Maximum Diameter (mm)	Minimum Depth of Cover (mm)	Class	Minimum Diameter (mm)	Maximum Diameter (mm)	Minimum Depth of Cover (mm)	
10	150	180	1200	10	150	180	1200	
	180	210	1500		20	150	180	1200
	210	240	1800			180	210	1500
	240	270	2100			210	240	1800
	270	300	2400			240	270	2100
20	300	330	2700	30	300	330	2700	
	330	360	3000		40	300	330	2700
	360	390	3300			330	360	3000
	390	420	3600			360	390	3300
30	420	450	3900	50	420	450	3900	
	450	480	4200		60	420	450	3900
	480	510	4500			450	480	4200
40	510	540	4800	75	510	540	4800	
	540	570	5100		90	510	540	4800
50	570	600	5400	105		570	600	5400
	600	630	5700		120	570	600	5400
60	630	660	6000	135		630	660	6000
	660	690	6300		150	630	660	6000
75	690	720	6600	165		690	720	6600
	720	750	6900		180	690	720	6600
90	750	780	7200	195		750	780	7200
	780	810	7500		210	750	780	7200
105	810	840	7800	225		810	840	7800
	840	870	8100		240	810	840	7800
120	870	900	8400	255		870	900	8400
	900	930	8700		270	870	900	8400
135	930	960	9000	285		930	960	9000
	960	990	9300		300	930	960	9000
150	990	1020	9600	315		990	1020	9600
	1020	1050	9900		330	990	1020	9600
165	1050	1080	10200	345		1050	1080	10200
	1080	1110	10500		360	1050	1080	10200
180	1110	1140	10800	375		1110	1140	10800
	1140	1170	11100		390	1110	1140	10800
195	1170	1200	11400	405		1170	1200	11400
	1200	1230	11700		420	1170	1200	11400
210	1230	1260	12000	435		1230	1260	12000
	1260	1290	12300		450	1230	1260	12000
225	1290	1320	12600	465		1290	1320	12600
	1320	1350	12900		480	1290	1320	12600
240	1350	1380	13200	495		1350	1380	13200
	1380	1410	13500		510	1350	1380	13200
255	1410	1440	13800	525		1410	1440	13800
	1440	1470	14100		540	1410	1440	13800
270	1470	1500	14400	555		1470	1500	14400
	1500	1530	14700		570	1470	1500	14400
285	1530	1560	15000	585		1530	1560	15000
	1560	1590	15300		600	1530	1560	15000
300	1590	1620	15600	615		1590	1620	15600
	1620	1650	15900		630	1590	1620	15600
315	1650	1680	16200	645		1650	1680	16200
	1680	1710	16500		660	1650	1680	16200
330	1710	1740	16800	675		1710	1740	16800
	1740	1770	17100		690	1710	1740	16800
345	1770	1800	17400	705		1770	1800	17400
	1800	1830	17700		720	1770	1800	17400
360	1830	1860	18000	735		1830	1860	18000
	1860	1890	18300		750	1830	1860	18000
375	1890	1920	18600	765		1890	1920	18600
	1920	1950	18900		780	1890	1920	18600
390	1950	1980	19200	795		1950	1980	19200
	1980	2010	19500		810	1950	1980	19200
405	2010	2040	19800	825		2010	2040	19800
	2040	2070	20100		840	2010	2040	19800
420	2070	2100	20400	855		2070	2100	20400
	2100	2130	20700		870	2070	2100	20400
435	2130	2160	21000	885		2130	2160	21000
	2160	2190	21300		900	2130	2160	21000
450	2190	2220	21600	915		2190	2220	21600
	2220	2250	21900		930	2190	2220	21600
465	2250	2280	22200	945		2250	2280	22200
	2280	2310	22500		960	2250	2280	22200
480	2310	2340	22800	975		2310	2340	22800
	2340	2370	23100		990	2310	2340	22800
495	2370	2400	23400	1005		2370	2400	23400
	2400	2430	23700		1020	2370	2400	23400
510	2430	2460	24000	1035		2430	2460	24000
	2460	2490	24300		1050	2430	2460	24000
525	2490	2520	24600	1065		2490	2520	24600
	2520	2550	24900		1080	2490	2520	24600
540	2550	2580	25200	1095		2550	2580	25200
	2580	2610	25500		1110	2550	2580	25200
555	2610	2640	25800	1125		2610	2640	25800
	2640	2670	26100		1140	2610	2640	25800
570	2670	2700	26400	1155		2670	2700	26400
	2700	2730	26700		1170	2670	2700	26400
585	2730	2760	27000	1185		2730	2760	27000
	2760	2790	27300		1200	2730	2760	27000
600	2790	2820	27600	1215		2790	2820	27600
	2820	2850	27900		1230	2790	2820	27600
615	2850	2880	28200	1245		2850	2880	28200
	2880	2910	28500		1260	2850	2880	28200
630	2910	2940	28800	1275		2910	2940	28800
	2940	2970	29100		1290	2910	2940	28800
645	2970	3000	29400	1305		2970	3000	29400
	3000	3030	29700		1320	2970	3000	29400
660	3030	3060	30000	1335		3030	3060	30000
	3060	3090	30300		1350	3030	3060	30000
675	3090	3120	30600	1365		3090	3120	30600
	3120	3150	30900		1380	3090	3120	30600
690	3150	3180	31200	1395		3150	3180	31200
	3180	3210	31500		1410	3150	3180	31200
705	3210	3240	31800	1425		3210	3240	31800
	3240	3270	32100		1440	3210	3240	31800
720	3270	3300	32400	1455		3270	3300	32400
	3300	3330	32700		1470	3270	3300	32400
735	3330	3360	33000	1485		3330	3360	33000
	3360	3390	33300		1500	3330	3360	33000
750	3390	3420	33600	1515		3390	3420	33600
	3420	3450	33900		1530	3390	3420	33600
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795	3570	3600	35400	1605		3570	3600	35400
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	3660	3690	36300		1650	3630	3660	36000
825	3690	3720	36600	1665		3690	3720	36600
	3720	3750	36900		1680	3690	3720	36600
840	3750	3780	37200	1695		3750	3780	37200
	3780	3810	37500		1710	3750	3780	37200
855	3810	3840	37800	1725		3810	3840	37800
	3840	3870	38100		1740	3810	3840	37800
870	3870	3900	38400	1755		3870	3900	38400
	3900	3930	38700		1770	3870	3900	38400
885	3930	3960	39000	1785		3930	3960	39000
	3960	3990	39300		1800	3930	3960	39000
900	3990	4020	39600	1815		3990	4020	39600
	4020	4050	39900		1830	3990	4020	39600
915	4050	4080	40200	1845		4050	4080	40200
	4080	4110	40500		1860	4050	4080	40200
930	4110	4140	40800	1875		4110	4140	40800
	4140	4170	41100		1890	4110	4140	40800
945	4170	4200	41400	1905		4170	4200	41400
	4200	4230	41700		1920	4170	4200	41400
960	4230	4260	42000	1935		4230	4260	42000
	4260	4290	42300		1950	4230	4260	42000

When

- New Standards and Project Special Provisions that accompany new Standards start with October 2009 letting
 - Section 300,
 - 3 standard drawings,
 - reinforced concrete pipe design >40'
- New special provision “Drainage Pipe” & Sec 310, Pipe Culverts starts with January 2010 letting
- Shown as special project detail in all plans until new standard book is issued

Summation

- New pipe standards designed to improve final product
- FHWA guidance requires competition through the use of alternate pipe materials
- Three new standard drawings
- New standards

Revisions An Overview

3 pages

- 300D01 – Method of Installation
Flexible Pipe
- 300D02 – Method of Installation
Rigid Pipe
- 300D03 – Method of Installation
Fill Height Tables

Rigid and Flexible

- **Rigid Pipe**

Concrete

Welded steel



Rigid and Flexible

- **Flexible Pipe (Except Structural Plate Pipe)**

Corrugated steel (no more BCCS),

Corrugated aluminum,

High density polyethylene (HDPE),

Polyvinylchloride (PVC)



Arch and Structural Plate Pipe

Included as special details when required

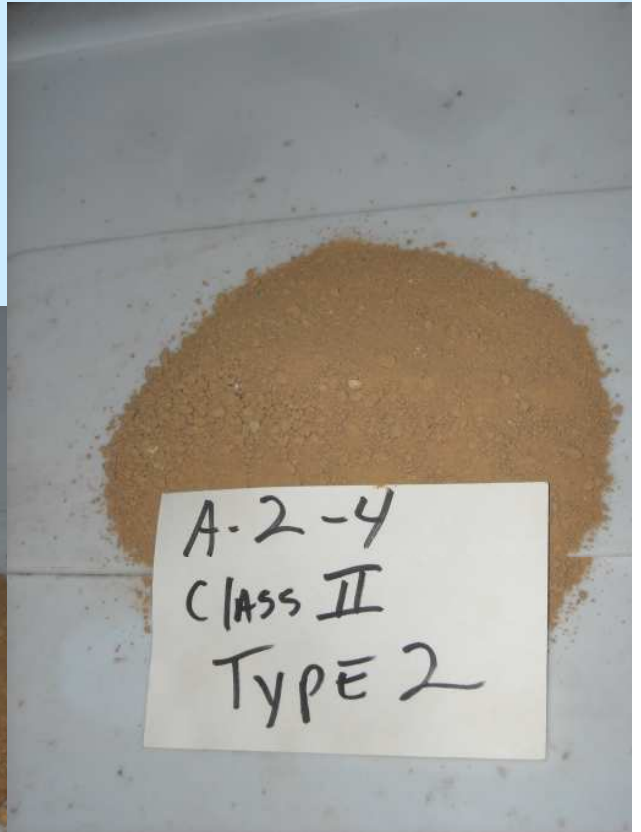
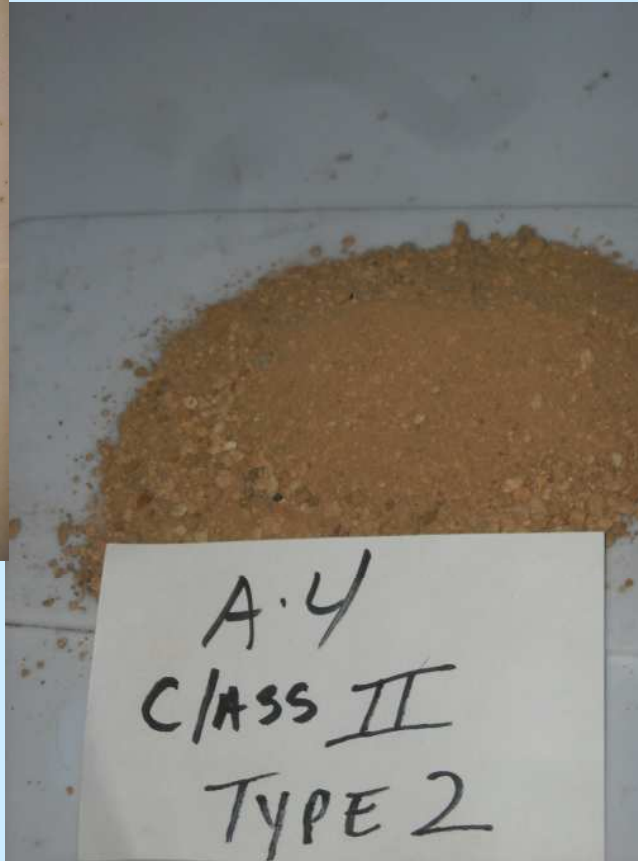
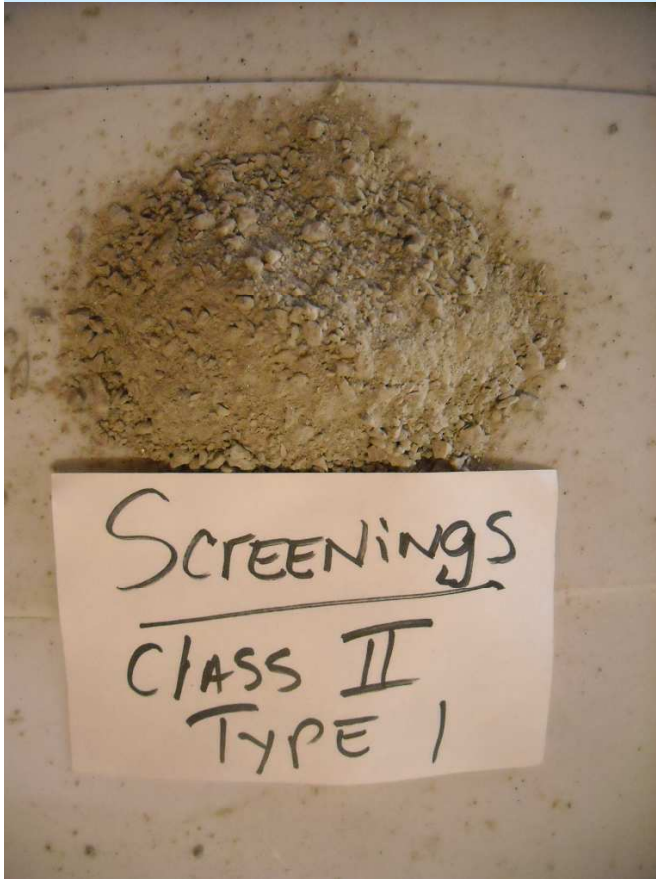
- Deep fill and steep grades
- Bottomless to reduce impacts to channels
- When minimal cover is available



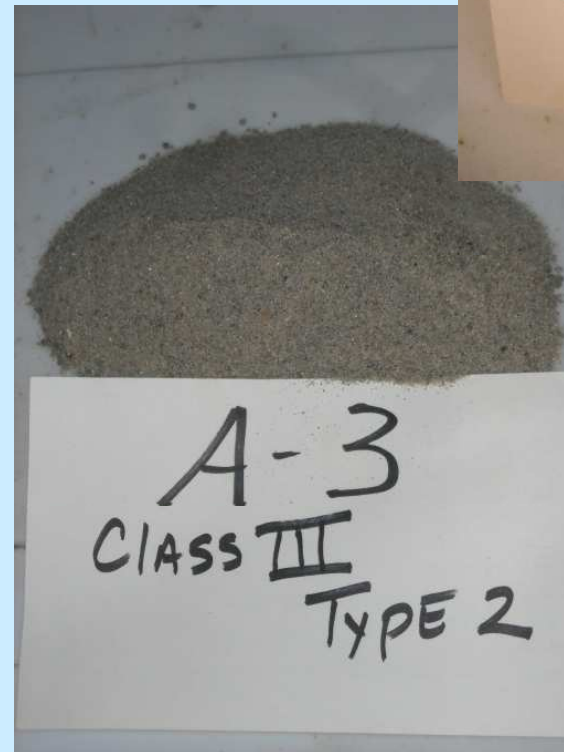
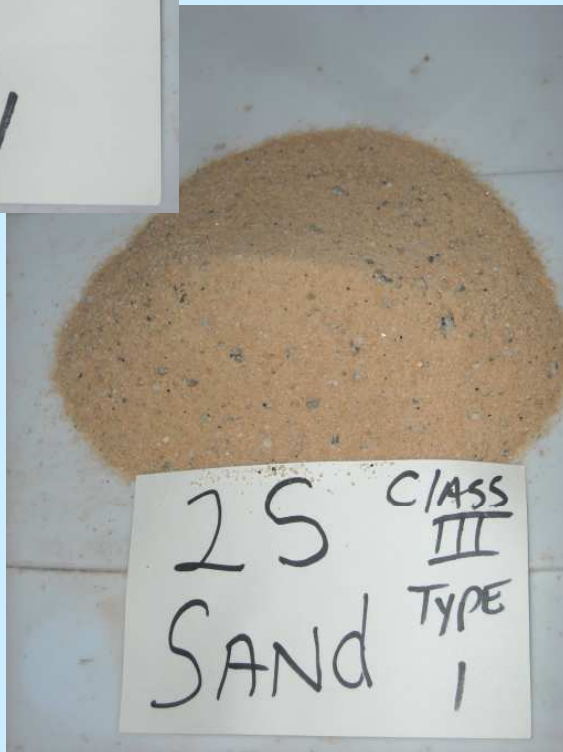
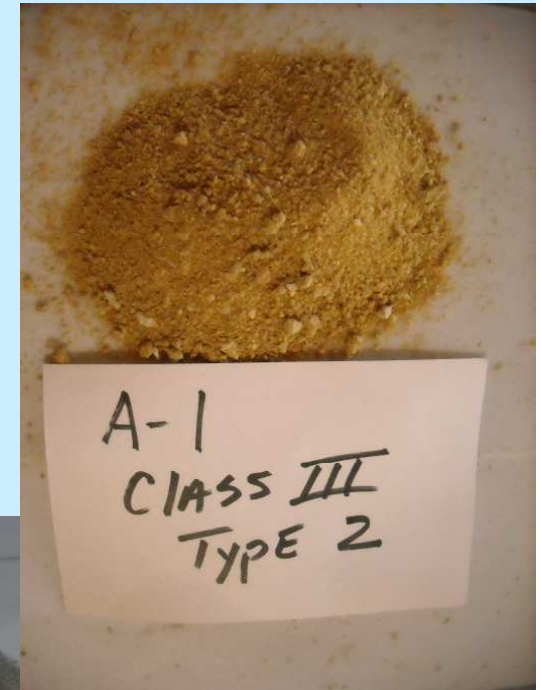
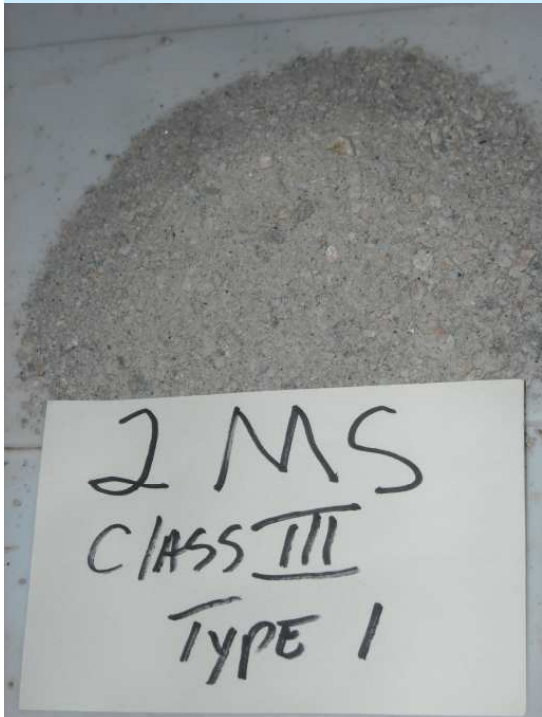
Select Material

- Foundation Conditioning – Class V or Class VI
- Pipe Bedding – Class III or Class II-Type 1 required for every pipe
- Pipe Backfill - Class III or Class II-(Type 1 for flexible, Type 1 or 2 for rigid) required for at least some portion of the backfill in every installation
- Amount and type of select backfill is dependent upon type of pipe and installation condition

Select Material Class 2



Select Material Class 3



Select Material Foundation Conditioning

- Class V or Class VI
 - **CLASS V**
Select Material is a coarse aggregate material meeting the gradation requirements of standard size 78M in Table 1005-1 as described in Sections 1005 and 1006.
 - **CLASS VI**
Select Material is a coarse aggregate material meeting the gradation requirements of standard size 57 in Table 1005-1 as described in Sections 1005 and 1006.
- Minimum Depth = 12”
- Old standard did not show stone under pipe for Rock Foundation
- Fabric wrap – prevent fines migration

Finally,
you can admit to putting stone under pipe!

Select Material Bedding

- Pipe Bedding – Class III or Class II Type 1 used under every installation. 6" min.

CLASS III (Sec. 1016)

Type 1 - Select Material is a natural or manufactured fine aggregate material meeting the gradation requirements of standard size 2S or 2MS in Table 1005-2 as described in Sections 1005 and 1006.

Type 2 - Select Material is a granular soil material meeting the requirements of AASHTO M145 for soil classification A-1 or A-3.

CLASS II

Type 1 - Select Material is a fine aggregate material consisting of crushed stone screenings (washed or unwashed) meeting the following gradation

Type 2 – Select Material is a granular soil material meeting the requirements of AASHTO M145 for soil classification A-2-4 with a maximum PI of 6 and A-4 soil containing 45% maximum passing a No. 200 sieve and a maximum PI of 6

- Sampling?

- How to ensure proper material is used (sample it unless it has already been sampled and passed for what you plan to use it for)

The proper material is critical as fill height tables are based on installation and materials used. Tables based on an analysis LRFD and AASHTO and ASTM by our Structure Design Unit and Geotechnical Unit. Proper backfill was a part of the design process and is critical in providing support to the pipe systems.

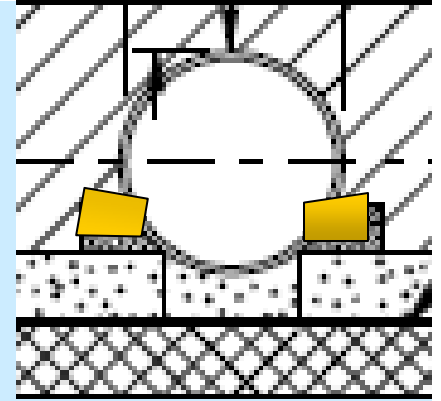
Summary

- Three new standard drawings
 - Effective with October 2009 letting
- Select material
 - Foundation Conditioning
 - Bedding

Trench Width Pipe in Trench

- From 2006 standard OD + 4ft to:
- New standard OD + 3ft
- Why?
 - More closely matches industry standard
 - Select material is easier to compact
 - Reduce amount of select material

Haunch Area



- Area adjacent to pipe that requires full compaction prior to further backfill
- Shown as a different symbol to draw attention to compaction; however, it is the same select material
- Remember, the area under the pipe is compacted by the pipe, the bedding is compacted with equipment then the haunch is full compacted prior to further fill.

Fill Height Tables

- Added to Standard Drawings so that field forces can cross reference the pipe type shown in the plans and drainage summary against the field fill height
- Based off finished subgrade elevation, not finished grade, not stone

Fill Height Table Changes

- No Method B
- Added Class II RCP
- Changed fill heights when compared to previous table.

Revisions

Changed fill heights when compared to previous table.

Pipe	Old Min	New Min	Old Max	New Max
24" RCP Cl. III	15"	24"	23'	20'
24" HDPE	12"	24"	20'	20'
24" Corr. Metal	13"	12"	36'(CS) 22'(AI)	100'(CS) 60'(AI)
24" PVC	12"	24"	20'	30'

Fill Height Table Changes

- No Method B
- Added Class II RCP
- Changed fill heights when compared to previous table.
- If the fill height (cover) is less than 2', then Class IV RCP or Class V RCP is required.

The differences in RCP classes are...

<p><u>“D” load strength of pipe</u></p> <p>Class II: 1,000 lb/ft/ft Class III: 1,350 lb/ft/ft Class IV: 2,000 lb/ft/ft Class V: 3,000 lb/ft/ft</p>	<p><u>Class of Concrete and Amount of Steel</u></p> <p>When moving from Cl. II to Cl. V, reinforcing steel amount nearly doubles for each class increase.</p> <p>Concrete class stays 4000 psi but increases to 6000 psi for Cl. V</p>
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	Typical Costs for various classes.				
	Class	II	III	IV	V
15"	RCP	\$8.50	\$8.50	\$10.63	\$11.48
18"	RCP	\$10.65	\$10.65	\$13.31	\$14.38
24"	RCP	\$14.10	\$14.10	\$17.63	\$19.04
30"	RCP	\$25.75	\$25.75	\$32.19	\$34.76

Fill Height Table Changes

- No Method B
- Added Class II RCP
- Changed fill heights when compared to previous table.
- If the fill height (cover) is less than 2', then Class IV RCP or Class V RCP is required
- The differences in RCP classes are:
- 1' minimum cover for side drain

Summary

- Trench widths
- Haunch
- Spring line
- Fill height tables

Standard Drawings

Flexible Pipe Standard Drawing Details

STATE OF NORTH CAROLINA
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DIVISION OF HIGHWAYS
RALEIGH, N.C.

STATE OF NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION
FLEXIBLE PIPE

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION
FLEXIBLE PIPE

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Flexible Pipe

What's the same for all foundation conditions?

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DIVISION OF HIGHWAYS
RALEIGH, N.C.

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION
FLEXIBLE PIPE

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION
FLEXIBLE PIPE

GENERAL NOTES:

E.D. = THE SPECIFIC HORIZONTAL INSIDE DIAMETER DIMENSION.

O.D. = THE SPECIFIC HORIZONTAL OUTSIDE DIAMETER DIMENSION.

H = THE FILL HEIGHT MEASURED VERTICALLY AT ANY POINT ALONG THE PIPE FROM THE TOP OF THE PIPE TO THE TOP OF THE CURBMENT AT THAT POINT.

THIS DATE TO FULLY COMBUST BURNER ZONE OF PIPE BACKFILL.

LOOSELY PLACED SELECT MATERIAL, CLASS III OR CLASS II, TYPE 1 FOR PIPE BACKFILL. LEAVE UNCOMPACTED DIRECTLY BELOW PIPE UNLESS OTHERWISE SPECIFIED. COMPACT ALL OTHER BACKFILL TO FULL DENSITY.

SELECT MATERIAL, CLASS III OR CLASS II, TYPE 1 FOR PIPE BACKFILL. LEAVE UNCOMPACTED DIRECTLY BELOW PIPE UNLESS OTHERWISE SPECIFIED. COMPACT ALL OTHER BACKFILL TO FULL DENSITY.

--- INSIDE OF PIPE

SELECT BACKFILL MATERIAL, CLASS III OR CLASS II, TYPE 1 ABOVE AND BELOW PIPE.

APPROVED SUITABLE LOCAL MATERIAL.

SEASONED EARTH MATERIAL.

SELECT MATERIAL, CLASS V OR VI FOR FOUNDATION CONSTRUCTION. ENCAPSULATE WITH IMPERMEABLE FOLDED AS DIRECTED BY THE ENGINEER.

DATE: 6/19/78

DRAFT STANDARD

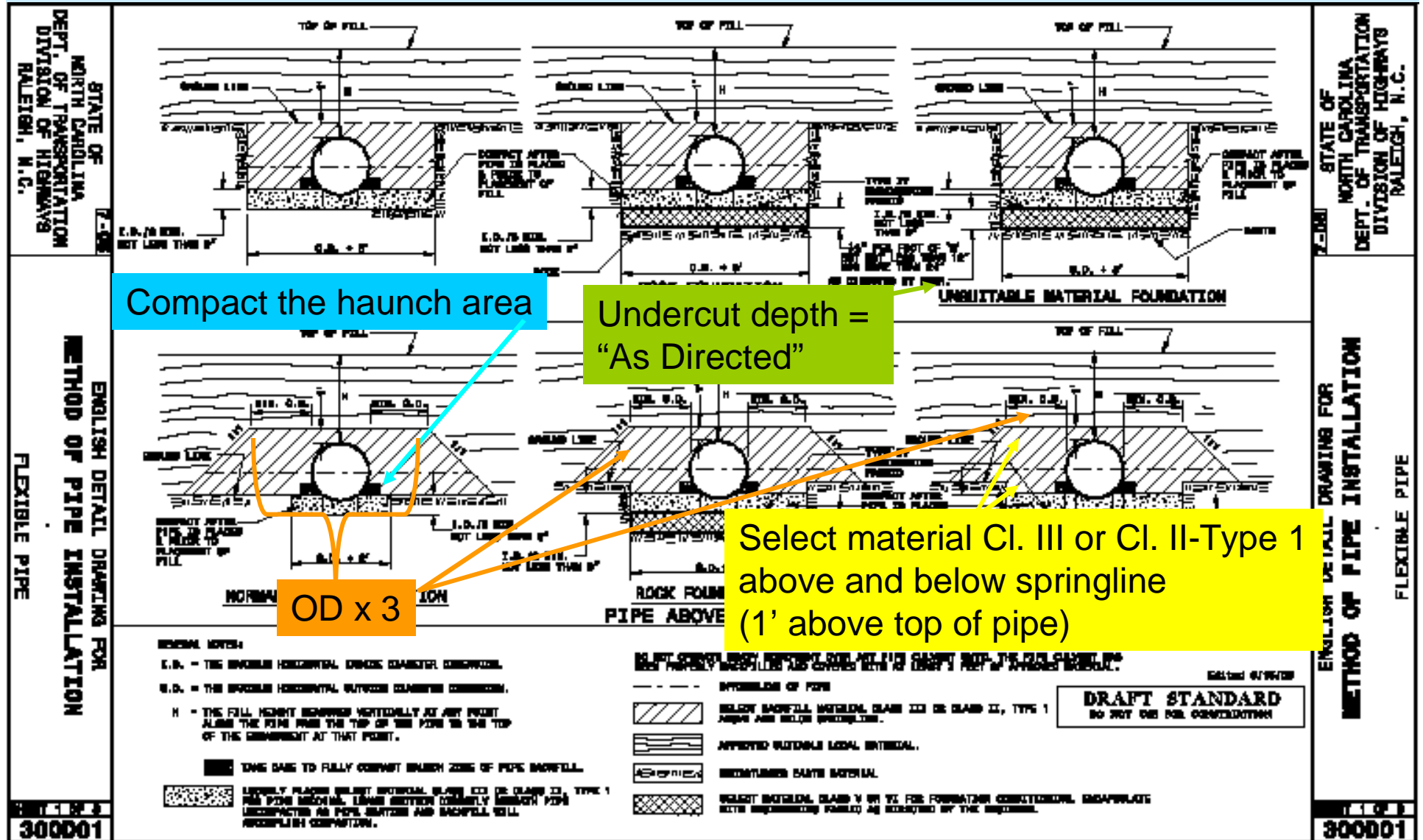
DO NOT USE FOR CONSTRUCTION

300001

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Flexible Pipe

What's the same for all foundation conditions?



Flexible Pipe Fill Height Table

Differences

HDPE max fill = 17' / 20'
 PVC max fill = 30'
 More fill can be placed over
 Corr. Steel than over Corr. Al.

Similar

Fill height measured to subgrade
 HDPE & PVC min. fill = 2'
 Corr. Metal min. fill = 1'

FLEXIBLE PIPE

Diameter (inches)	Minimum cover (inches)	Maximum Height of Cover (feet)	
		1D	2
15	12	162	204
18	12	136	189
21	12	116	145
24	12	100	125
30	12	79	100
36	12	65	83
42	12	55	70
48	12	48	61
54	12	44	54
60	12	39	50
66	12	35	45
72	12	31	41
78	12	28	36

Diameter (inches)	Minimum cover (inches)	Maximum Height of Cover (feet)			
		1D	1 1/2	2	2 1/2
12	12	123	155	218	281
15	12	98	128	174	224
18	12	81	102	144	187
21	12	69	87	123	160
24	12	60	75	108	139
27	12	54	67	95	123
30	12	49	60	85	111
36	12	42	50	71	92
42	12	37	44	60	78
48	12	33	39	52	68
54	12	30	36	48	60
60	12	27	33	44	56
66	12	25	31	41	51
72	12	23	29	38	47

The Engineer should determine when a fill height change requires a pipe type change.

Side drain cover = 1' min

RIGID PIPE

- RCP - * (Minimum fill) 1' for Class IV & Class V
2' for Class III & Class II
- * (Maximum fill) 10' - Class II pipe
20' - Class III pipe
30' - Class IV pipe
40' - Class V pipe

(For fills > 40' & < 60' use LRFD Direct Design Method)

* FILL HEIGHT IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT STRUCTURE

REFER TO THE FOLLOWING FOR PIPE SPECIFICATIONS

RCP - AASHTO M170

NOTES: FILL HEIGHTS SHOWN WERE CALCULATED USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

1' MINIMUM COVER FOR ALL SIDE DRAIN PIPE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS

SHEET 3 OF 3
300D01

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION

FILL HEIGHT TABLES

STATE OF
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DIVISION OF HIGHWAYS
RALEIGH, N.C.

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION

FILL HEIGHT TABLES

SHEET 3 OF 3
300D01

Summary

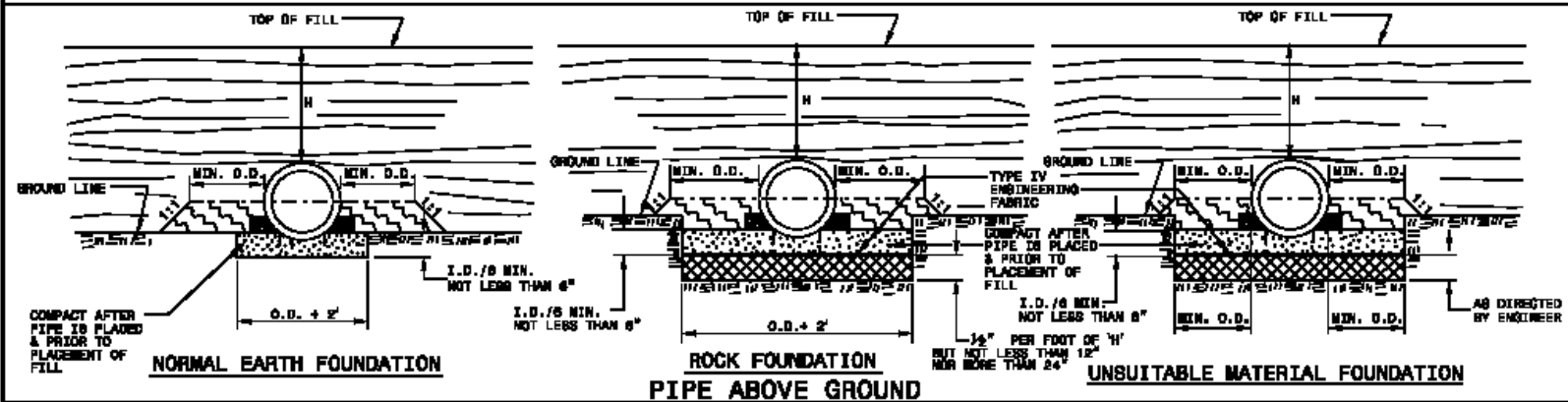
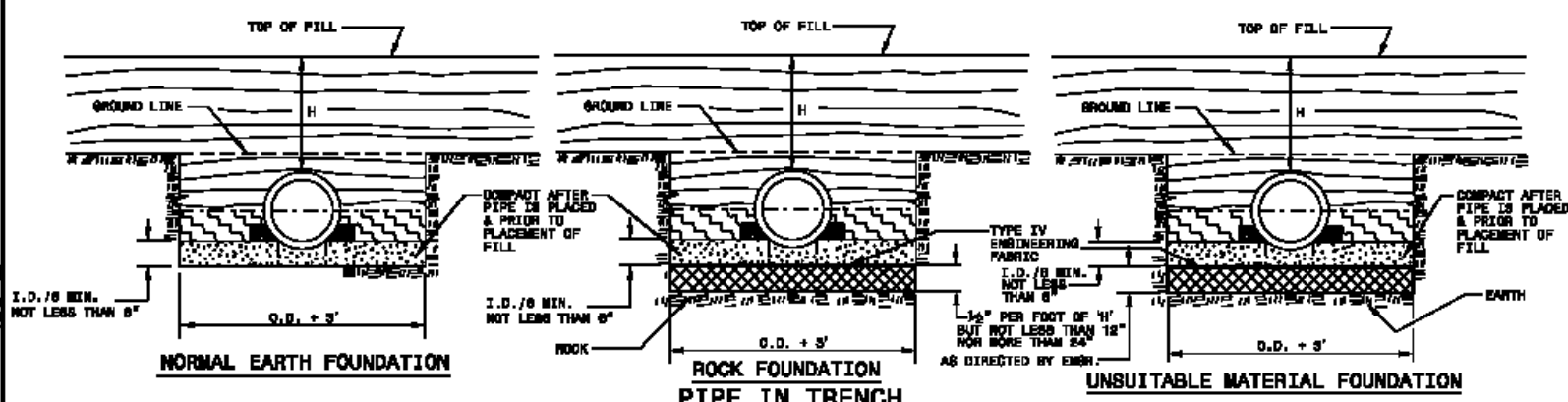
Flexible Pipe

- Foundation conditioning depth and type
- Bedding material type and depth
- Haunch
- Fill height

Rigid Pipe Standard Drawing Details

STATE OF
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DIVISION OF HIGHWAYS
RALEIGH, N.C.

STATE OF
NORTH CAROLINA
DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
RALEIGH, N.C.



GENERAL NOTES:

I.D. = THE MAXIMUM HORIZONTAL INSIDE DIAMETER DIMENSION.

O.D. = THE MAXIMUM HORIZONTAL OUTSIDE DIAMETER DIMENSION.

H = THE FILL HEIGHT MEASURED VERTICALLY AT ANY POINT ALONG THE PIPE FROM THE TOP OF THE PIPE TO THE TOP OF THE EMBANKMENT AT THAT POINT.

TAKE CARE TO FULLY COMPACT HAUNCH ZONE OF PIPE BACKFILL.

LOOSELY PLACED SELECT MATERIAL CLASS III OR CLASS II, TYPE 1 FOR PIPE BEDDING; LEAVE BEDDING DIRECTLY BENEATH PIPE UNCOMPACTED AS PIPE SEATING AND BACKFILL WILL ACCOMPLISH COMPACTION.

DO NOT OPERATE HEAVY EQUIPMENT OVER ANY PIPE CULVERT UNTIL THE PIPE CULVERT HAS BEEN PROPERLY BACKFILLED AND COVERED WITH AT LEAST 3 FEET OF APPROVED MATERIAL.

--- SPRINGLINE OF PIPE

SELECT BACKFILL MATERIAL CLASS III OR CLASS II, BELOW SPRINGLINE.

APPROVED SUITABLE LOCAL MATERIAL ABOVE SPRINGLINE.

UNDISTURBED EARTH MATERIAL

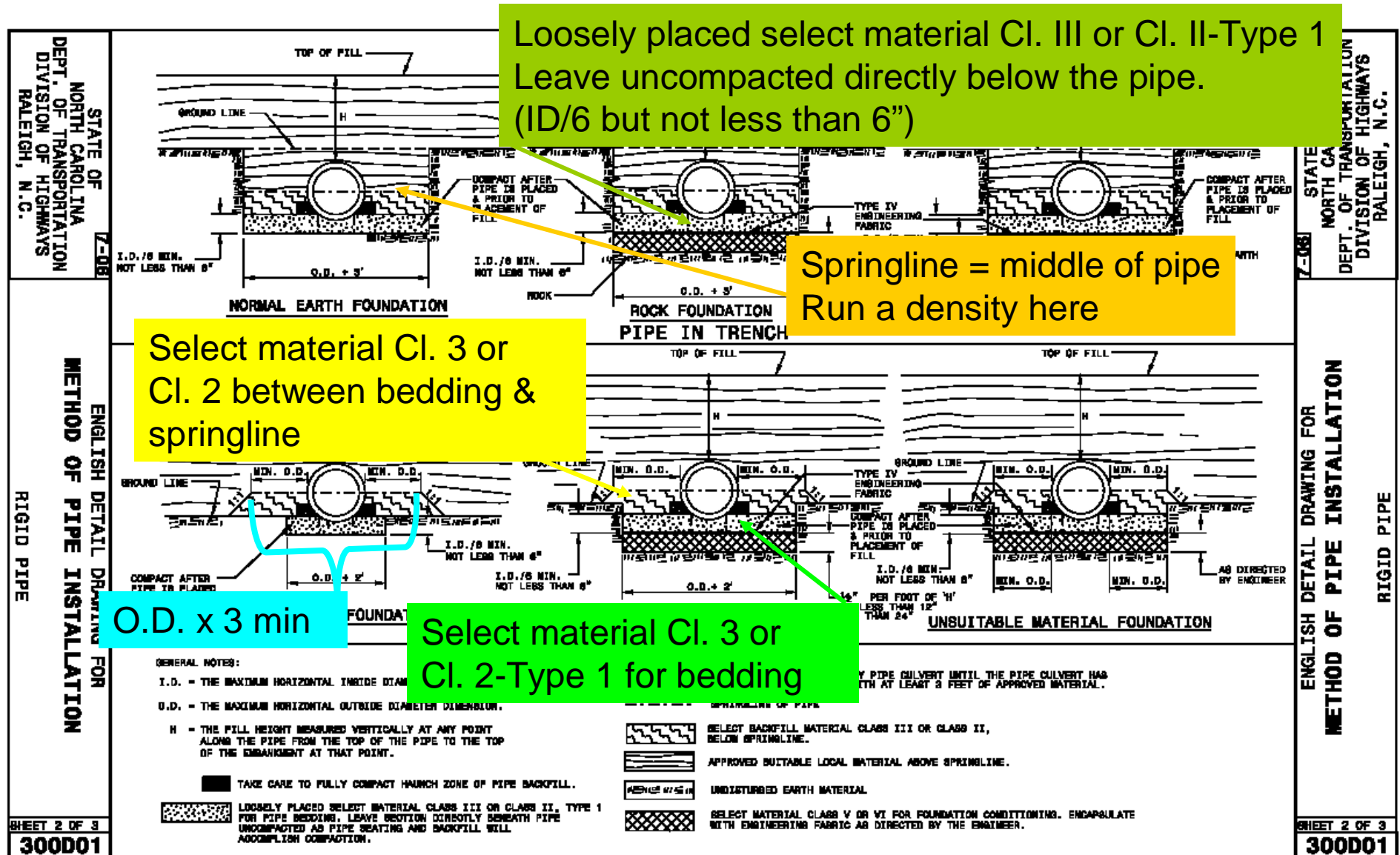
SELECT MATERIAL CLASS V OR VI FOR FOUNDATION CONDITIONING. ENCAPSULATE WITH ENGINEERING FABRIC AS DIRECTED BY THE ENGINEER.

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION
RIGID PIPE

ENGLISH DETAIL DRAWING FOR
METHOD OF PIPE INSTALLATION
RIGID PIPE

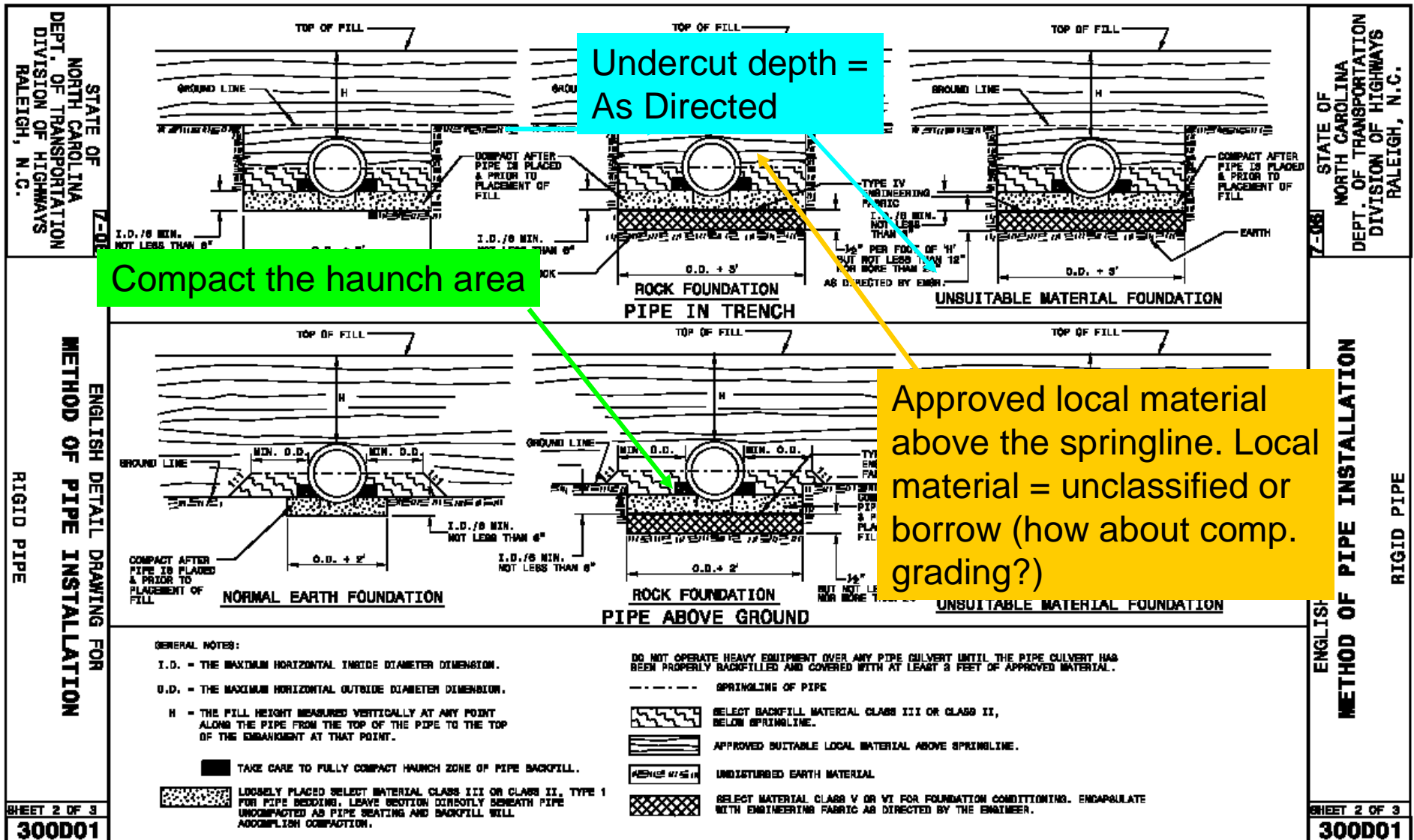
Rigid Pipe

What's similar for all foundation conditions?



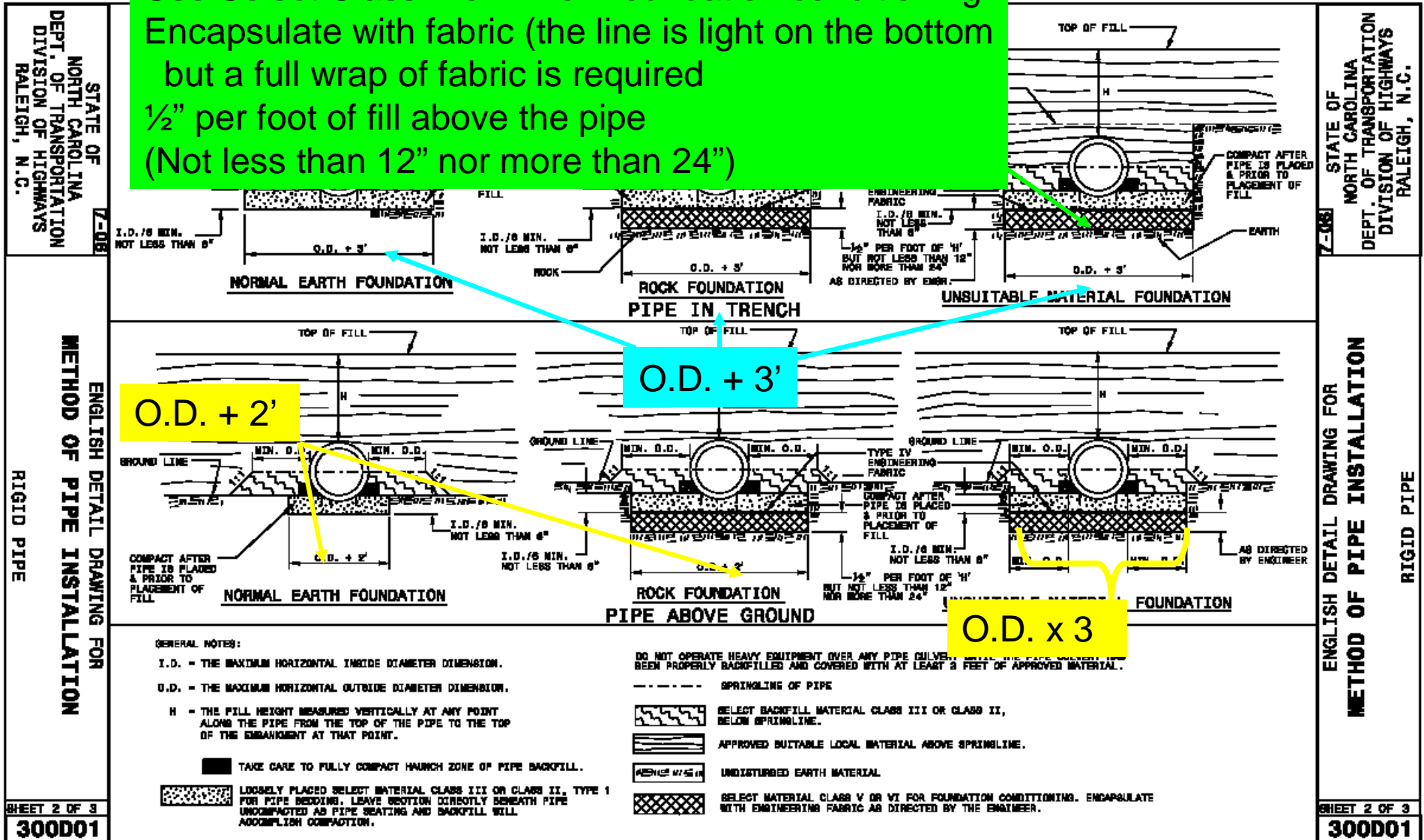
Rigid Pipe

What's similar for all foundation conditions?



Rigid Pipe Find the differences

Use Select Class V or VI for Foundation conditioning
Encapsulate with fabric (the line is light on the bottom but a full wrap of fabric is required
 $\frac{1}{2}$ " per foot of fill above the pipe
(Not less than 12" nor more than 24")



Rigid Pipe Fill Height Tables

STATE OF NORTH CAROLINA DEPT. OF TRANSPORTATION DIVISION OF HIGHWAYS RALEIGH, N.C.	<p style="text-align: center;">Round Corrugated Steel Pipe 2 2/3 x 1/2 corrugation **</p> <table border="1"> <thead> <tr> <th rowspan="2">Diameter (inches)</th> <th rowspan="2">Minimum cover (inches)</th> <th colspan="2">Maximum Height (ft)</th> </tr> <tr> <th>18"</th> <th>14"</th> </tr> </thead> <tbody> <tr><td>12</td><td>12</td><td>204</td><td>256</td></tr> <tr><td>15</td><td>12</td><td>182</td><td>204</td></tr> <tr><td>18</td><td>12</td><td>135</td><td>189</td></tr> <tr><td>24</td><td>12</td><td>115</td><td>145</td></tr> <tr><td></td><td></td><td>125</td><td>1</td></tr> <tr><td></td><td></td><td>100</td><td>1</td></tr> <tr><td></td><td></td><td>83</td><td>1</td></tr> <tr><td></td><td></td><td>70</td><td>1</td></tr> <tr><td></td><td></td><td>81</td><td>87</td></tr> <tr><td></td><td></td><td>84</td><td>77</td></tr> <tr><td></td><td></td><td>89</td><td>60</td></tr> <tr><td></td><td></td><td></td><td>81</td></tr> <tr><td></td><td></td><td></td><td>74</td></tr> <tr><td></td><td></td><td></td><td>81</td></tr> <tr><td></td><td></td><td></td><td>89</td></tr> </tbody> </table>	Diameter (inches)	Minimum cover (inches)	Maximum Height (ft)		18"	14"	12	12	204	256	15	12	182	204	18	12	135	189	24	12	115	145			125	1			100	1			83	1			70	1			81	87			84	77			89	60				81				74				81				89	<p style="text-align: center;">Round Corrugated Aluminum Pipe 2 2/3 x 1/2 corrugation **</p> <table border="1"> <thead> <tr> <th rowspan="2">Diameter (inches)</th> <th rowspan="2">Minimum cover (inches)</th> <th colspan="5">Maximum Height of Cover (feet)</th> </tr> <tr> <th>18"</th> <th>14"</th> <th>12"</th> <th>10"</th> <th>8"</th> </tr> </thead> <tbody> <tr><td>12</td><td>12</td><td>123</td><td>155</td><td>218</td><td>281</td><td>344</td></tr> <tr><td>42</td><td>12</td><td></td><td></td><td>60</td><td>78</td><td>86</td></tr> <tr><td>48</td><td>12</td><td></td><td></td><td>52</td><td>68</td><td>84</td></tr> <tr><td>54</td><td>12</td><td></td><td></td><td>48</td><td>58</td><td>74</td></tr> <tr><td>60</td><td>12</td><td></td><td></td><td></td><td>50</td><td>62</td></tr> <tr><td>66</td><td>12</td><td></td><td></td><td></td><td></td><td>51</td></tr> <tr><td>72</td><td>12</td><td></td><td></td><td></td><td></td><td>41</td></tr> </tbody> </table>	Diameter (inches)	Minimum cover (inches)	Maximum Height of Cover (feet)					18"	14"	12"	10"	8"	12	12	123	155	218	281	344	42	12			60	78	86	48	12			52	68	84	54	12			48	58	74	60	12				50	62	66	12					51	72	12					41	STATE OF NORTH CAROLINA DEPT. OF TRANSPORTATION DIVISION OF HIGHWAYS RALEIGH, N.C.
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ENGLISH DETAIL DRAWING FOR METHOD OF PIPE INSTALLATION FILL HEIGHT TABLES	<p style="text-align: center;">Minimum fill</p> <p>Cl. III = 2' Cl. IV & V = 1'</p> <p style="text-align: center;">Maximum fill</p> <p>Cl. II = 10' Cl. III = 20' Cl. IV = 30' Cl. V = 40'</p> <p style="text-align: center;">Side drain cover = 1' min</p> <p>HDPE - * (Minimum fill) 2' for pipe diameters $\geq 12"$ and $\leq 60"$ * (Maximum fill) 20' for pipe diameters $\leq 24"$ 17' for pipe diameters $\geq 30"$ and $\leq 60"$</p> <p>PVC - * (Minimum fill) 2' for pipe diameters $\geq 12"$ and $\leq 36"$ * (Maximum fill) 30' for pipe diameters $\geq 12"$ and $\leq 36"$</p> <p>* FILL HEIGHT IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT STRUCTURE</p>	<p>** FOR DIFFERENT CORRUGATIONS AND ARCH PIPES REFER TO ROADWAY DESIGN MANUAL OR MANUFACTURERS SPECIFICATION.</p> <p>REFER TO THE FOLLOWING FOR PIPE SPECIFICATIONS</p> <p>CSP - AASHTO M36 CAAP - AASHTO M198 HDPE - AASHTO M204 PVC - ASTM F848 or AASHTO M304</p> <p>NOTES: FILL HEIGHTS SHOWN WERE CALCULATED USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS</p> <p>1' MINIMUM COVER FOR ALL SIDE DRAIN PIPE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS</p>	ENGLISH DETAIL DRAWING FOR METHOD OF PIPE INSTALLATION FILL HEIGHT TABLES																																																																																																																															
SHEET 3 OF 3 300D01	<p>RCP - * (Minimum fill) 1' for Class IV & CLASS V 2' for Class III & Class II</p> <p>* (Maximum fill) 10' - Class II pipe 20' - Class III pipe 30' - Class IV pipe 40' - Class V pipe</p> <p>(For fills > 40' & < 80' use LRFD Direct Design Method)</p> <p>* FILL HEIGHT IS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF THE PAVEMENT STRUCTURE</p>	<p>NOTES: FILL HEIGHTS SHOWN WERE CALCULATED USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS</p> <p>1' MINIMUM COVER FOR ALL SIDE DRAIN PIPE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS</p>	SHEET 3 OF 3 300D01																																																																																																																															

Minimum fill
Cl. III = 2'
Cl. IV & V = 1'

Maximum fill
Cl. II = 10'
Cl. III = 20'
Cl. IV = 30'
Cl. V = 40'

If fill height exceeds 40',
LRFD design is required

Side drain cover = 1' min

The Engineer should determine when
a fill height change requires a pipe type
change.

Fill heights > 40'

REINFORCED CONCRETE PIPE DESIGN

(5-27-09)

1.0 GENERAL

This Special Provision covers the design and manufacture of reinforced concrete pipes which require fills greater than 40' and less than or equal to 80'.

When the design of a reinforced concrete pipe is required in the contract plans, design the reinforced concrete pipe in accordance with the current edition of the AASHTO LRFD Bridge Design Specifications. Provide the diameter of pipe as indicated on the plans and manufacture the pipe in accordance with ASTM C 1417. Provide a reinforced concrete pipe that meets the requirements of Section 1032-9, Section 1077 and any other applicable parts of the Standard Specifications.

The design of the reinforced concrete pipe is the responsibility of the Contractor and is subject to review, comments and approval. Submit two sets of detailed plans for review. Include all details in the plans, including the size and spacing of the required reinforcement necessary to fabricate the reinforced concrete pipe. Include checked design calculations for the reinforced concrete pipe. Have a North Carolina Registered Professional Engineer seal the plans and design calculations. After the plans are reviewed and, if necessary, the corrections made, submit one set of reproducible tracings on 22" x 34" sheets to become part of the contract plans.

2.0 REINFORCED CONCRETE PIPE SECTIONS

A. Class

Reinforced concrete pipe sections manufactured in accordance with this Special Provision are designated by inside pipe diameter and design earth cover.

B. Design Criteria

The design of the reinforced concrete pipe shall be in accordance with Article 12.10.4.2 "Direct Design Method" of the current edition of the AASHTO LRFD Bridge Design Specifications. The following assumptions shall be used in the design calculations:

NCDOT Criteria for Direct Design Method
Process and Material Factors, Radial Tension, $F_{rp}=1.0$ Shear Strength, $F_{sp}=1.0$
Design Concrete Strength - f'_c $5,000 \text{ psi} < f'_c < 7,000 \text{ psi}$
Heger Pressure Distribution - Type 2 Installation Vertical Arching Factor = 1.40 Horizontal Arching Factor = 0.40
Soil Unit Weight = 120 lb/ft ³
Depth of Fluid = Inside Pipe Diameter
Minimum Concrete Cover = 1.00"
Crack Control = 0.90 (maximum)

Send to:
Contract Standards
and Development
Joel Howerton -
Standards Engineer

Tech needs a copy of
approved submittal to inspect.

Summary

Rigid Pipe

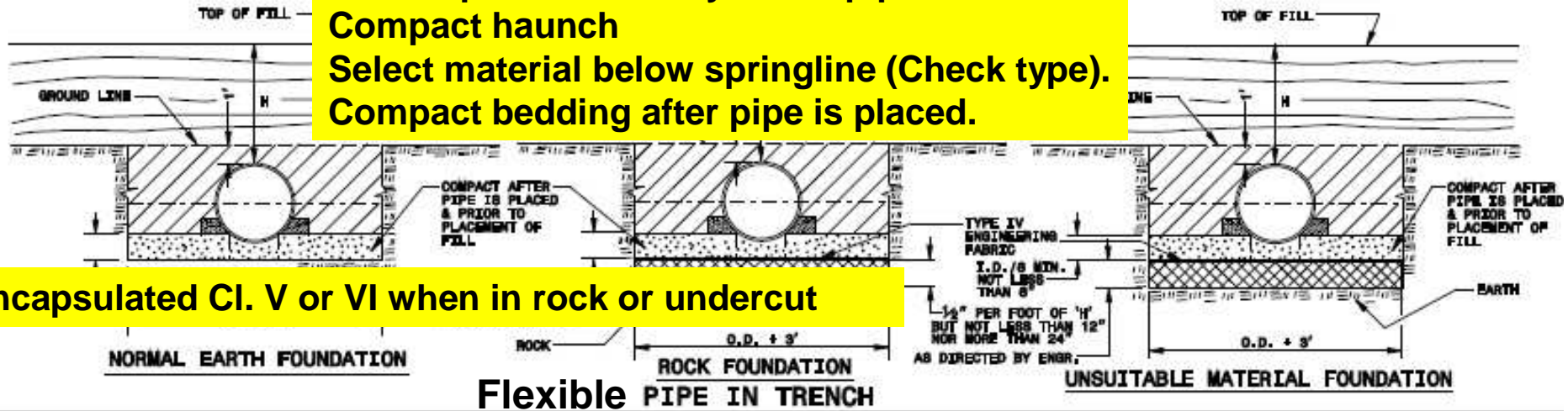
- Foundation conditioning material and depth
- Bedding type and depth
- Fill above springline
- Fill height
- Reinforced Concrete Pipe Design

Standard Comparison Summary In Trench

Similarities

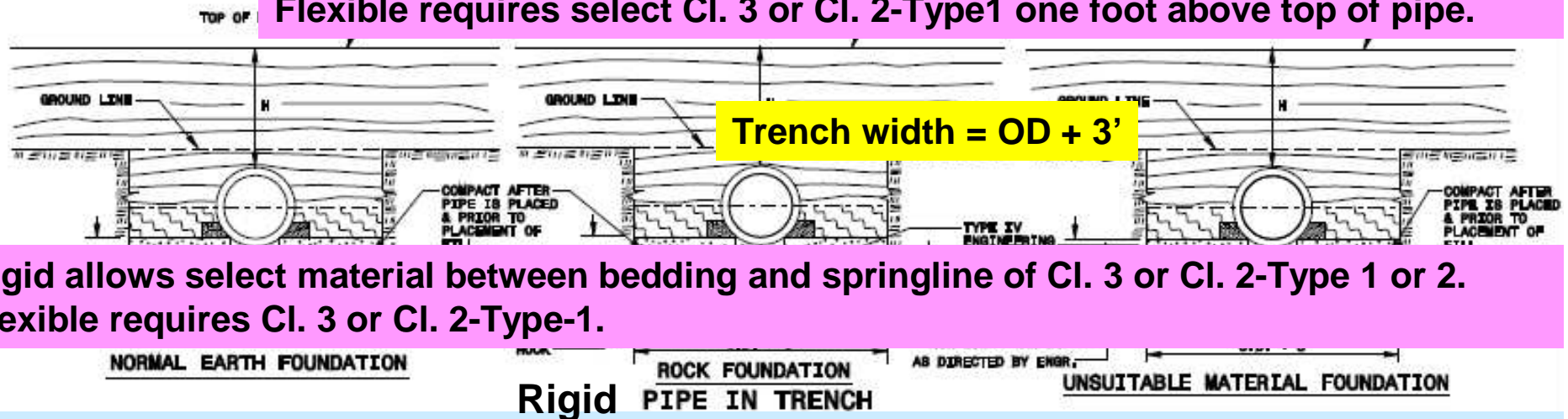
Differences

6" min pipe bedding
 No compaction directly under pipe
 Compact haunch
 Select material below springline (Check type).
 Compact bedding after pipe is placed.



Encapsulated Cl. V or VI when in rock or undercut

Rigid allows approved local material above springline.
 Flexible requires select Cl. 3 or Cl. 2-Type1 one foot above top of pipe.



Rigid allows select material between bedding and springline of Cl. 3 or Cl. 2-Type 1 or 2.
 Flexible requires Cl. 3 or Cl. 2-Type-1.

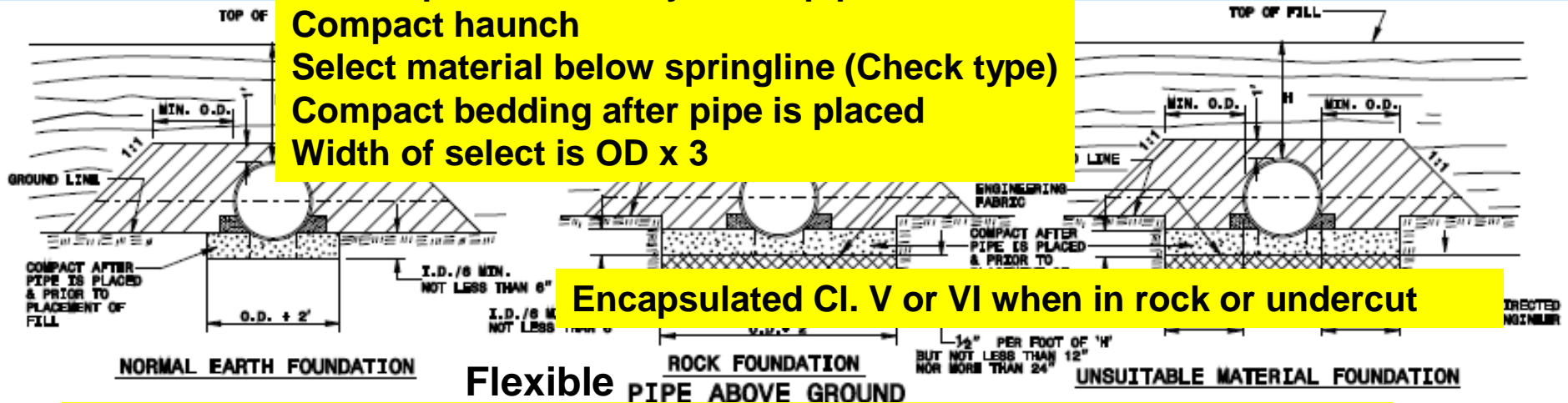
Standard Comparison Summary

Similarities

Above Ground

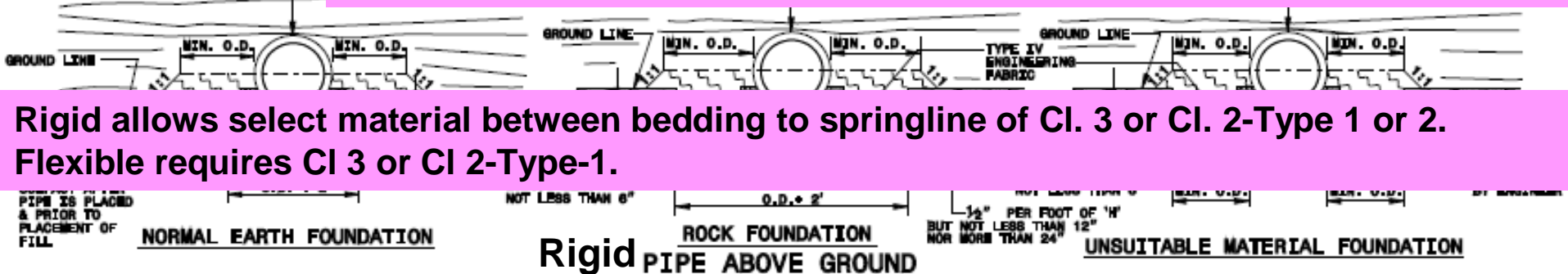
Differences

6" min pipe bedding
 No compaction directly under pipe
 Compact haunch
 Select material below springline (Check type)
 Compact bedding after pipe is placed
 Width of select is OD x 3



Flexible and Rigid require a bedding width of $OD + 2'$; however, both also require a bedding width of $OD \times 3$ for unsuitable foundations.

Rigid allows approved local material above springline.
 Flexible requires select Cl. 3 or Cl. 2-Type1 one foot above top of pipe.



Rigid allows select material between bedding to springline of Cl. 3 or Cl. 2-Type 1 or 2.
 Flexible requires Cl 3 or Cl 2-Type-1.

Installation v. Material Requirements

Foundation condition	Normal	Rock	Unsuitable	Backfill Differences
Flexible	Bedding Select Cl. III or Cl. II-Type 1	Bedding Select Cl. III or Cl. II-Type 1 + Fnd. Cond. Select Cl. V or VI w/ fabric	Bedding Select Cl. III or Cl. II-Type 1 + Fnd. Cond. Select Cl. V or VI w/ fabric	Select Cl. 3 or Cl. 2-Type 1 1' above top of pipe
Rigid	Bedding Select Cl. III or Cl. II- Type 1.	Bedding Select Cl. III or Cl. II-Type 1 + Fnd. Cond. Select Cl. V or VI w/ fabric	Bedding Select Cl. III or Cl. II-Type 1 + Fnd. Cond. Select Cl. V or VI w/ fabric	Select Cl 3 or Cl. 2 (Type 1 or Type 2) between bedding and springline Approved local material above springline

Provisions

PIPE ALTERNATES:

(7-18-06) (Rev 4-17-07)

Description

The Contractor may substitute Aluminized Corrugated Steel Pipe, Type IR or HDPE Pipe, Type S or Type D up to 48 inches in diameter in lieu of concrete pipe in accordance with the following requirements.

Material

Item

HDPE Pipe, Type S or D

Aluminized Corrugated Steel Pipe, Type IR

Section

1032-10

1032-3(A)(7)

Aluminized Corrugated Steel Pipe will not be permitted in counties listed in Article 310-2 of the *2006 Standard Specifications*.

Construction Methods

Aluminized Corrugated Steel Pipe Culverts and HDPE Pipe Culverts shall be installed in accordance with the requirements of Section 300 of the *2006 Standard Specifications* for Method A, except that the minimum cover shall be at least 12 inches. Aluminized Corrugated Steel Pipe Culvert and HDPE Pipe Culvert will not be permitted for use under travelways, including curb and gutter.

Measurement and Payment

____ "Aluminized Corrugated Steel Pipe Culvert to be paid for will be the actual number of linear feet installed and accepted. Measurement will be in accordance with Section 310-6 of the *2006 Standard Specifications*.

____ "HDPE Pipe Culvert to be paid for will be the actual number of linear feet installed and accepted. Measurement will be in accordance with Section 310-6 of the *2006 Standard Specifications*.

Payment will be made under:

Pay Item

____ " Aluminized Corrugated Steel Pipe Culverts, ____" Thick

____ " HDPE Pipe Culverts

Pay Unit

Linear Foot

Linear Foot

Since June 2006, we used it.

Had restrictions that limited it to drives and outside ditches

In Jan 2010, Drainage Pipe special provision that will expand the use of alternates.

Side drain provision and drainage pipe provision will replace alt pipe provision.

Where will new provisions be used?

- For Statewide Tier, Drainage Pipe Special Provision will not be in contract.
- Side drain will be in all contracts.
- For all projects other than Statewide Tier, “Drainage Pipe” will be a SP.
- Subregional - SR Routes (The road to grandma’s house)
- Regional - US and NC routes not on the Statewide Tier
- Statewide Tier – The Strategic Highway Corridor Network as approved by the Board of Transportation (Interstate and major US)
- **The Tier Type will be shown on the plan cover sheet.**
- **Side drains** – Storm drain pipes running parallel to the roadway to include pipes in medians, outside ditches, driveways, and under shoulder berm gutter along outside shoulders greater than 4 feet wide. May or may not be open ended.
- **Storm drain systems** – Lateral drain pipe under curb and gutter, expressway gutter, and shoulder berm gutter (with shoulders 4 feet wide or less) that connect drainage structures and is not open ended. Also includes cross drains connecting two or more systems or system outlets.
- **Transverse median drains** – shallow cross drain pipe that collects drainage in a median ditch or curb section and deposits it outside ditches or natural drainage channels. May or may not be open ended.

Show type of pipe used on as-built for use in system inventory and asset management.

Key Changes

- No more unreinforced concrete pipe. Now Cl. II RCP
- Side drain in both Statewide and Regional/Subregional Tier
- Only smooth inside wall pipe is allowed in Storm Drain Systems.
- Exceptions will be noted in Remarks column of Drainage Summary.
- Drainage pipe pay items will be shown as SP.

Show type of pipe used on as built for use in system inventory and asset management.

Provisions

Regional/Subregional Tier

Drainage pipe could be RCP, HDPE, PVC, CSP, CAAP unless Remarks list exclusions.

Side drain pipe
Fill < 10'
Not in commercial drive
Not if future widening planned

STATION		LOCATION (L.T. RT. OR CL)	STRUCTURE NO.	TOP ELEVATION	INVERT ELEVATION	INVERT ELEVATION	SLOPE CRITICAL	DRAINAGE PIPE (RCP, CSP, CAAP, HDPE or PVC)												C.S. PIPE (UNLESS NOTED OTHERWISE)												CLASS III R.C. PIPE (UNLESS NOTED OTHERWISE)												END WALLS		QUANTITIES FOR DRAINAGE STRUCTURES (TOTAL LF. FOR RAY QUANTITY SHALL BE COL. 'A' + (1/3) COL. 'B')	FRAME, GRATES, AND HOOD STANDARD 840.02	CONCRETE TRANSITIONAL SECTION	CATCH BASIN	D.I. STD. 840.14 OR STD. 840.15	D.I. FRAME AND GRATE STD. 840.16	S.D.I. TYPE 'A' STD. 840.17 OR 840.26	S.D.I. TYPE 'B' STD. 840.18 OR 840.27	S.D.I. TYPE 'C' STD. 840.19 OR 840.28	S.D.I. FRAME WITH GRATE STD. 840.29	S.D.I. FRAME WITH TWO GRATES STD. 840.22	S.D.I. (N.S.) FRAME WITH GRATE STD. 840.24	S.D.I. (N.S.) FRAME WITH TWO GRATES STD. 840.24	J.B. STD. 840.31 OR 840.32	MANHOLE STD. 840.31	M.H. STD. 840.31 OR 840.33	M.H. FRAME AND COVER STD. 840.34	CORR. STEEL BLP	CONC. COLLARS C	CONC. & BRICK PP	PIPE REMOVAL LP	T.B.D.I.	TRAFFIC BEARING DROP INLET	T.B.J.B.	TRAFFIC BEARING JUNCTION BOX	REMARKS
SIZE	THICKNESS OR GAUGE							FROM	TO	12"	15"	18"	24"	30"	36"	42"	48"	12"	15"	18"	24"	30"	36"	42"	48"	12"	15"	18"	24"	30"	36"	42"	48"	PER BACK (0 THRU 5.0')	5.0 THRU 10.0'	10.0' AND ABOVE	IN.	FT.	TYPE OF GRATE	E	F	G	CU. YARDS	R.C.P.	C.S.P.																										
COMPUTED BY:		CHECKED BY:		CLASS III R.C. PIPE		DIVISION OF HIGHWAYS		SHEET NO.																																																															
Print Half Size		Print Full Size		Drainage pipe could be RCP, HDPE, PVC, CSP, CAAP unless Remarks list exclusions.		Side drain pipe Fill < 10' Not in commercial drive Not if future widening planned		If fill height is > 20' or < 2' then type of pipe will be specified.																																																															
Example of when a type may be excluded: Where pipe connects a storm drain system. So from DI to DI in shoulder berm gutter would not allow pipe with corrugations inside but from DI to DI in the median does allow corrugations inside pipe. Why: corrugations interfere with capacity calc.		Example: RCP is excluded where grade >10% such as outlets from SBG.		Will there be side drain pipe and Drainage Pipe in the same contract? If YES, why?		Counties: 310-2 - No Corrugated Steel in 24 coastal counties																																																																	
SHEET TOTALS																																																																							

Summary

New Provisions Application

- Tiers
- Drainage pipe on Statewide Tier only
- Side Drain may be on all tiers
- Exceptions noted in remarks of drainage summary

Drainage Pipe - Special Provision

DRAINAGE PIPE:
(7-18-06) (Rev 7-17-09)

SP3 R___

Description

Where shown in the plans the Contractor may use Reinforced Concrete Pipe, Aluminum Alloy Pipe, Aluminized Corrugated Steel Pipe, HDPE Pipe, or PVC pipe in accordance with the following requirements.

Material

Item	Section
Corrugated Aluminum Alloy Pipe	1032-2(A)
Aluminized Corrugated Steel Pipe	1032-3(A)(7)
Corrugated Polyethylene Pipe (HDPE)	1032-10
Reinforced Concrete Pipe – Class II or III	1032-9(C)
Polyvinyl-Chloride (PVC)	1032-11

Corrugated Steel Pipe will not be permitted in counties listed in Article 310-2 of the 2006 *Standard Specifications*.

Only pipe with smooth inside walls will be allowed for storm drain systems. Storm drain systems are defined as pipe under curb and gutter, expressway gutter, and shoulder berm gutter that connects drainage structures and is not open ended.



Construction Methods

Pipe Culverts shall be installed in accordance with the contract documents.

Where allowed by the plans, use any of the several alternate pipes shown herein, but only one type of pipe will be permitted between drainage structures or for the entire length of a cross line pipe.

Measurement and Payment

Measurement will be in accordance with Section 310-6 of the 2006 *Standard Specifications*. ___" *Drainage Pipe* will be paid for as the actual number of linear feet installed and accepted.

Payment will be made under:

Pay Item
___" Drainage Pipe

Pay Unit
Linear Foot

Jan. 2010 let

Provision Revisions

- 300-2: Bedding material and foundation conditioning material
- 300-4: Class V or VI select encapsulated with fabric
- 300-6: RCP Pipe > 42" use fabric that extends 12" on both sides of joint
- 300-7: Loosely place bedding material, in a uniform layer, a depth equal to the inside diameter of the pipe divided by 6 or 6 inches, whichever is greater. Leave bedding material directly beneath the pipe uncompacted and allow pipe seating and backfill to accomplish compaction. Excavate recesses to receive the bells where bells and spigot type pipe is used.
Excavatable flowable fill may be used for backfill when approved by the Engineer. When using excavatable flowable fill, ensure that the pipe is not displaced and does not float during backfill. Submit methods for supporting the pipe and material placement to the engineer for review and approval.
- 300-8: Prior to final acceptance, the Engineer will perform random video camera and or mandrel inspections to ensure proper jointing and that deformations do not exceed allowable limits. Replace pipes having cracks greater than 0.1 inches or deflections greater than 7.5%. Repair or replace pipes with cracks greater than 0.01 inches, exhibiting displacement across a crack, exhibiting bulges, creases, tears, spalls, or delamination.

Provision Revisions

- RCP Pipe > 42” use fabric that extends 12” on both sides of joint.



- Excavatable flowable fill is acceptable.
- Ensure pipe does not float.
- Submit plan detailing pipe support and method to prevent floating.

Provisions continued

- 300-9:
- Foundation Conditioning Fabric
Fabric for Foundation Conditioning will be measured and paid for in square yards. The measurement will be based on the theoretical calculation using length of pipe installed and two times the standard trench width. No separate measurement will be made for overlapping fabric or the vertical fabric dimensions required to encapsulate the foundation conditioning material.
- Bedding and Backfill - Select Material
No measurement will be made for select bedding and backfill material required in the contract documents. The select bedding and backfill material will be included in the cost of the installed pipe.

Where unclassified excavation or borrow material meets the requirements for select bedding and backfill and is approved for use by the Engineer, no deductions will be made to these pay items to account for use in the pipe installation.

Provisions continued

- **No measurement will be made for select bedding and backfill material required in the contract documents.**
- **The select bedding and backfill material will be included in the cost of the installed pipe.**

Provisions Continued

- 310-4: SIDE DRAIN PIPE

Side drain pipe is defined as storm drain pipe running parallel to the roadway to include pipe in medians, outside ditches, driveways, and under shoulder berm gutter along outside shoulders greater than 4 feet wide.

Where shown in the plans, side drain pipe may be class II reinforced concrete pipe, aluminized corrugated steel pipe, corrugated aluminum alloy pipe, HDPE pipe, or PVC pipe. Corrugated steel pipe is restricted in the counties listed in 310-2. Install side drain pipe in accordance to Section 300. Minimum cover for side drain pipe is one foot.

- 310-6: MEASUREMENT AND PAYMENT

Pipe will be measured and paid for as the actual number of linear feet of pipe that has been incorporated into the completed and accepted work. Select bedding and backfill material will be included in the cost of the installed pipe.

Post Installation Inspection

- **300-8 INSPECTION AND MAINTENANCE**

Prior to final acceptance, the Engineer will perform random video camera and or mandrel inspections to ensure proper jointing and that deformations do not exceed allowable limits. Replace pipes having cracks greater than 0.1 inches or deflections greater than 7.5%. Repair or replace pipes with cracks greater than 0.01 inches, exhibiting displacement across a crack, exhibiting bulges, creases, tears, spalls, or delamination.

Nominal Size	Base ID	5% Deflection	7 1/2% Deflection
		Mandrel Size	Mandrel Size
15"	13.898	13.20	12.86
18"	16.976	16.13	15.70
24"	22.480	21.36	20.79
36"	34.869	33.13	32.25

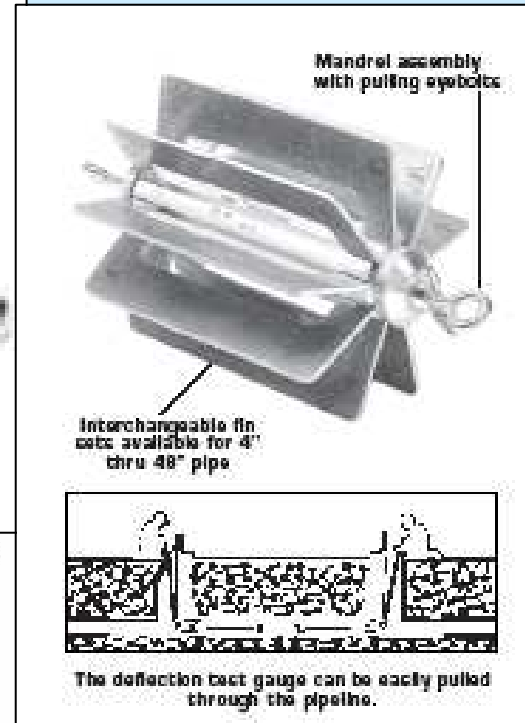
- **Replace pipe with cracks > 0.1" or deflections > 7.5%**

- **Repair or replace pipe with cracks > 0.01" which show displacement, spalls etc.**

Post Installation Inspection



Nominal Size	Base ID	5% Deflection Mandrel Size	7 1/2% Deflection Mandrel Size
15"	13.898	13.20	12.86
18"	16.976	16.13	15.70
24"	22.480	21.36	20.79
36"	34.869	33.13	32.25



Post Installation Inspection

- Begins where?
 - Stick your head in the pipe.
 - Use a flash light.
 - Begins when?

Approx. 30 days after fill has been completed to subgrade
 - Pipes to check:
 - A % of cross lines
 - Video (add how to request camera)
 - Video inspection request form
 - Very deep or very shallow pipe under roadway
 - When visual inspection shows abnormalities
 - Where heavy loads have operated over pipe
- When a problem such as settlement or sediment is noted

Other specification changes

- Section 310
 - Deleted BCCSP, Vitrified Clay, Concrete lined steel
- Section 1032
 - Deleted BCCSP
 - Aluminized coating is required for corrugated steel, added polymer coated corrugated steel pipe as an option

Standards and Provision Implementation Summary

- October 2009
 - New Standard Drawings and Fill Height Table
 - New Specification Section 300
 - New Specification “Reinforced Concrete Pipe Design” for fills > 40’
- January 2010
 - New Specification “Drainage Pipe”
 - Revised Specification “Culvert Pipe”
 - New Specification Section 300 (includes 310)

Summary Provisions

- Drainage pipe special provision
- Foundation Conditioning and fabric
- Bedding type and depth
- Pipe wrap
- Flowable fill
- Post installation inspection
- Side drain

Pay Items?

- Pavement removal
 - NO. 300-9 – Removal part of pipe installation
- Island, sidewalk and driveway removal
 - NO. 300-9 – NO
- Excavation
 - NO. 300-9
- Pipe removal
 - MAYBE – 340-4 – No measurement if new pipe is placed in same trench
- Keeping foundation dry
 - MAYBE
 - Yes – If impervious dike is shown in plans with pay items, then pay.
 - No – 300-4 - Maintain foundation in dry condition
- Undercut
 - MAYBE
 - Yes – 300-9 - Double unclassified, if local foundation cond. is used.
 - No – 300-9 – Undercut is incidental if “other than local” foundation conditioning material is trucked in. (This will almost always be the case.)

Pay Items? continued

- Foundation Conditioning Fabric
 - Yes – Based on the length of pipe and two times the standard trench width. No pay for the vertical dimension
- Foundation Condition
 - Yes – Paid by ton when hauled from off site
 - Yes – Not deducted from borrow or unclassified when local is used
- Pipe
 - YES – 310-6 – Count # of joints. Partial joints to 0.1ft
- Select backfill & bedding
 - NO – 300-9 – No measurement for bedding and backfill except that no deduction is made if material comes from borrow or unclassified
- Pavement patching
 - YES – 654-4 – Actual # of tons

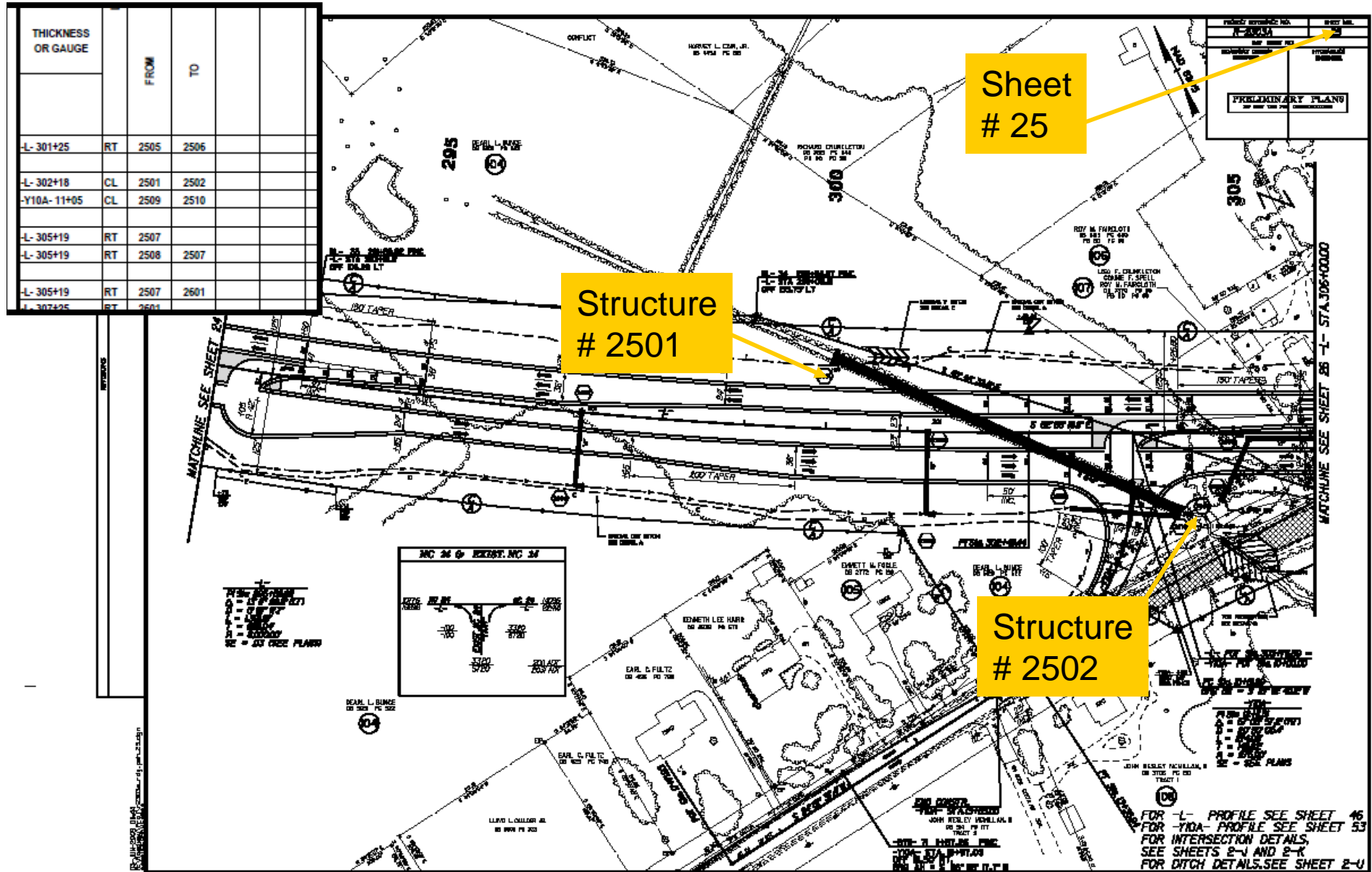
Drainage Structure Number Scheme

- This convention will combine the plan page number with the sequential number of the drainage structure on that particular plan sheet. So, the first pipe outlet or drainage structure on plan sheet 25 will be identified as 2501.
- This is an aid in the design phase and should assist in quickly referencing drainage during construction.

Revised network numbering scheme

- First two numbers = plan sheet number
- Next two numbers = drainage structure number
- Numbers start over with each sheet

Design



Summary

Pay Items & Miscellaneous

- Incidental
 - Pavement, island, sidewalk, etc. removal
 - Excavation
 - Fabric pipe wrap
 - All bedding
 - Backfill up to 1' above flexible pipe & up to springline for rigid pipe
- Possible Pay Item
 - Pipe removal
 - Undercut
 - Draining foundation
- Pay Item
 - Foundation Conditioning
 - Fabric wrapping foundation conditioning
 - Pipe
 - Patching
- Network Numbering

Critical Inspection Points

- When pipe is delivered
- At bottom of excavation
- Placing fabric and select CL V(78) or VI(57)
- Placing Select CL III or II
- Bailing pipe
- Compacting haunch
- Backfill to spring line
- Conducting pipe density

Looks like pretty much the entire time doesn't it

Possible failures and causes

- **Cracking and deformation**
 - **Too little cover**
 - Crack > 0.1" = replace
 - Crack > 0.01" = repair or replace
 - Deformation
 - **Pour backfill technique**
- **Too little cover during construction (as materials are being hauled)**
 - **Not ramped with 3' minimum cover. Take care when minimum cover is used if there is hauling to take place. Earthen ramps placed to protect pipes will be removed just prior to fine grading.**
- **Joint separation**
 - **Constant inspection prior to backfill**
- **Connections to drainage structures fail**
 - **Grout cracks**
 - **Short joint of pipe (air brick)**
- **Damage from other operations**
 - **Guardrail**
 - **Signs**
 - **Signal drilling**

Keys to Success

- Inspection
- Foundation
- Inspection
- Backfill
- Inspection
- Joints
- Inspection
- Cover
- Inspection